

Chapter Nine

Molecular Geometries and Bonding Theories

1. *Which of the following species does NOT have tetrahedral geometry?*

- a) CH₄
- b) SF₄
- c) SO₄²⁻
- d) SiCl₄

2. Using the VSEPR method, which species does not exhibit a trigonal planar molecular geometry?

- a) NO_3^-
- b) NH_3
- c) SO_3
- d) BF_3

3. ***What is the electron domain geometry of CCl_4 ?***

- a) Square planar
- b) Tetrahedral
- c) Octahedral
- d) Trigonal pyramid

4. What is the molecular geometry of the ICl_4^- ion according to the VSEPR method?

- a) tetrahedral
- b) trigonal planar
- c) seesaw
- d) square planar

5. Which of the following compounds has the same molecular geometry as its electron domain geometry?

- a) SO_2
- b) NH_3
- c) H_2O
- d) NH_4^+

6. In BF_4^- , what are the:

(i) electron group geometry around B?

(ii) molecular geometry?

- a) (i) trigonal planar, (ii) trigonal planar
- b) (i) tetrahedral, (ii) tetrahedral
- c) (i) trigonal bipyramidal, (ii) seesaw
- d) (i) octahedral, (ii) square planar

7. In IBr_4^- , what are the:

(i) electron group geometry around I

(ii) molecular geometry?

- a) (i) octahedral, (ii) tetrahedral
- b) (i) octahedral, (ii) square planar
- c) (i) square bipyramidal, (ii) seesaw
- d) (i) tetrahedral, (ii) tetrahedral

8. Which one of the following molecules adopts tetrahedral geometry and is polar?

- a) CCl_4
- b) CHBr_3
- c) SF_3Cl
- d) ICl_4^-

9. Which of these molecules has a zero net dipole moment?

- a) OCS
- b) BF₂Cl
- c) PF₅
- d) SiF₂Cl₂

10. What is the hybridization state of N in NCI_3 ?

- a) sp
- b) sp^2
- c) sp^3
- d) sp^4

11. *What is the hybridization of orbitals on phosphorus in PH_3 ?*

- a) sp^4
- b) sp^3
- c) sp^2
- d) sp

12. How many sigma (σ) and pi (π) bonds are in a CH_2CHCH_3 molecule?

- a) 9 σ , 0 π
- b) 7 σ , 2 π
- c) 8 σ , 1 π
- d) 8 σ , 2 π

13. Which one of the following best describes the bond in F_2 using valence bond theory?

- a) The end-to-end overlap of a $2p$ orbital of one fluorine atom with a $2p$ orbital of the other fluorine atom.
- b) The sideways overlap of a $2p$ orbital of one fluorine atom with a $2p$ orbital of the other fluorine atom.
- c) The overlap of a $2s$ orbital of one fluorine atom with a $2s$ orbital of the other fluorine atom.
- d) The overlap of a $2s$ orbital of one fluorine atom with the $2p$ orbital of the other fluorine atom.

14. All of the following statements concerning molecular orbital (MO) theory are correct except

- a) Pauli exclusion principle is obeyed.
- b) electrons are assigned to orbitals of successively higher energy.
- c) Hund's rule is obeyed.
- d) the combination of two atomic orbitals creates one molecular orbital.

15. Using molecular orbital theory, list the following diatomic molecules in order of increasing stability (from least stable to most stable). (Hint: molecule stability depends on the bond order)

- a) $\text{N}_2 < \text{B}_2 < \text{C}_2$
- b) $\text{C}_2 < \text{N}_2 < \text{B}_2$
- c) $\text{B}_2 < \text{C}_2 < \text{N}_2$
- d) $\text{B}_2 < \text{N}_2 < \text{C}_2$

16. What is the bond order of F_2^{2-} ?

- a) 0
- b) $\frac{1}{2}$
- c) 1
- d) 2

17. Based on the molecular orbital diagram for the N_2^+ ion choose the *FALSE* statement.

- a) The bond order of N_2^+ is 2.5.
- b) The N_2^+ ion is paramagnetic.
- c) The Bond order is lower than in the N_2 molecule.
- d) The N_2^+ ion is diamagnetic.